Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3624159715

BIOLOGY **9700/53**

Paper 5 Planning, Analysis and Evaluation **May/June 2014**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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1 **(a)** In an investigation to study genetic variation, DNA was obtained from four varieties of the same invertebrate species.

The following technique was used:

- DNA was digested using a number of different restriction enzymes to obtain fragments of between 200 – 700 base pairs in length, each of which have sticky ends.
- Known RNA sequences (RNA probes) were used to select DNA fragments with specific sticky ends and to separate them from the rest of the DNA.
- Multiple copies of the DNA fragments that hybridised with the DNA were made (DNA amplification).
- The fragments were separated by gel electrophoresis to give a genetic fingerprint called an amplified fragment length polymorphism (AFLP).

(i) Explain how RNA probes, used in this technique, select fragments of DNA.

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.....[2]

(ii) This technique is able to separate small DNA fragments that may differ by only one nucleotide. Suggest why this technique is used to study genetic variation within species.

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(b) Describe the main stages used in gel electrophoresis to separate and locate the amplified DNA fragments.

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.....[5]

(c) Three groups of students used gel electrophoresis to separate a set of DNA fragments from each of the four varieties.

State two variables that the students should standardise to ensure that their results from gel electrophoresis can be compared.

1. .....

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2. .....

.....[2]

(d) Three different groups of RNA probes, **A**, **B** and **C**, were used to select different DNA fragments from all four varieties of the invertebrate species, 1, 2, 3 and 4.
Gel electrophoresis was then used to separate the fragments.
Fig. 1.1 shows the results.

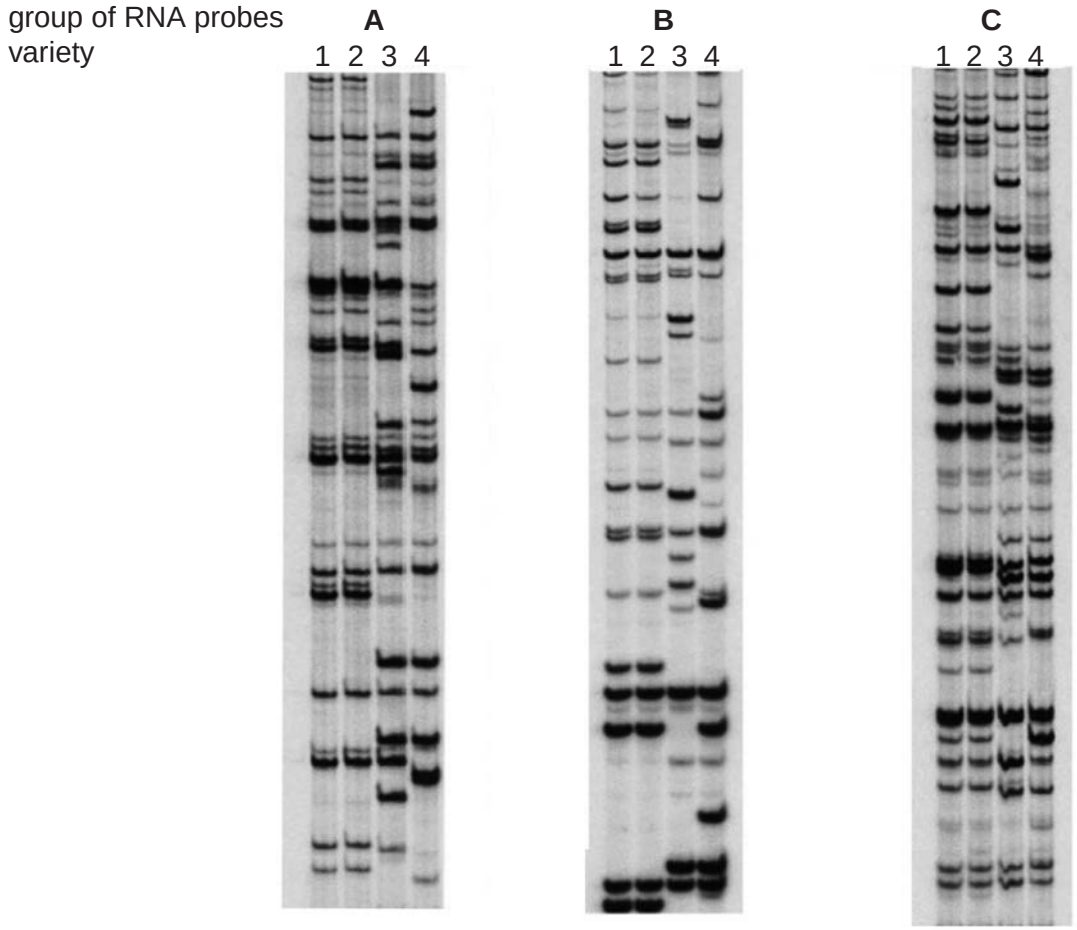


Fig. 1.1

(i) Fig. 1.1 shows that some DNA fragments are present in the genetic fingerprints of all four varieties, 1, 2, 3 and 4, when the different groups of RNA probes, **A**, **B** and **C**, are used.

On Fig. 1.1:
- draw an arrow (⟶) to indicate **one** DNA fragment found in all four varieties when RNA probes in group **A** were used.
- draw a second arrow for the RNA probes used in group **B**
- draw a third arrow for the RNA probes used in group **C**. [1]

(ii) State the varieties that appear to have the same genetic fingerprint. Give the evidence for your answer.

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.....[2]

[Total: 14]

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2 **(a)** Green manuring is a method of fertilising soil. One type of plant is grown for a certain period of time and then ploughed into the soil while the plants are still green.

A field investigation into the effect of green manuring on the yield of *Sorghum bicolor* was carried out using a legume. Different parts of the legume were used as green manure.

The *Sorghum* was grown in four types of trial plot as follows:

- no treatment (control)
- legume roots only ploughed into the soil
- legume shoots only ploughed into the soil
- both legume roots and shoots ploughed into the soil.

Fig. 2.1 shows the arrangement of trial plots used for the investigation.
A random number generator was used to locate each of the trial plots.

trial plots, 5 m × 5 m, separated by fences

control	shoots and roots	roots only	control	roots only	roots only	shoots and roots	shoots only
shoots and roots	roots only	shoots only	shoots only	control	shoots and roots	shoots only	control

Fig. 2.1

The trial plots were left for one month before the *Sorghum* grain was sown.

Fig. 2.2 shows how the grain was sown in each trial plot.

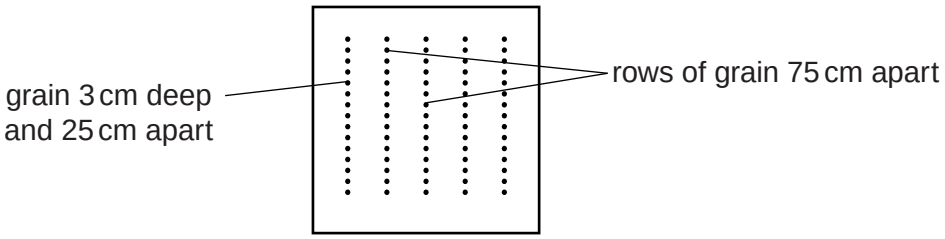


Fig. 2.2

(i) Identify two variables that have been standardised in this field investigation.

1. .....

2. .....[1]

(ii) Suggest two **abiotic** variables that **cannot** be standardised in this field investigation.

1. .....

2. .....[2]

(iii) Suggest why the plots used to grow the *Sorghum* were left for one month before the sowing of the grain.

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(iv) State how this experimental design helps to ensure the reliability of the results.

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(b) *Sorghum* from each of the trial plots was collected and the dry mass of the different parts of the plants determined. The mean dry mass of shoot, roots and grain was calculated.

Table 2.1 shows the results of this investigation.

Table 2.1

treatment	mean dry mass of *Sorghum* / kg per hectare			
	shoots	roots	grain	whole plant
no treatment (control)	3831	2486	398	6715
roots only	4773	2744	526	8043
shoots only	5645	3252	782	9679
roots and shoots	5923	3707	975	10605

(i) Calculate the percentage increase in dry mass of whole *Sorghum* plants as a result of fertilising the soil with legume shoots only. Show your working.

.....[2]

(ii) The increase in dry mass of grain caused by using legume roots as green manure is 128 kg per hectare.
Calculate the ratio of the increase in the mean dry mass of grain caused by using legume shoots in comparison to using legume roots only as green manure. Show your working.

.....[2]

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(c) Table 2.2 shows the results of *t*-tests that were carried out to compare the effect of the different types of green manure on the dry mass of *Sorghum.*

In each test the plants with added manure were compared with the control.

Table 2.2

treatment	P < 0.05			
	shoots	roots	grain	whole plant
legume roots only	not significant	not significant	not significant	not significant
legume shoots only	not significant	not significant	significant	significant
legume roots and shoots	significant	significant	significant	significant

(i) Suggest a null hypothesis for the statistical tests.

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.....[1]

(ii) State a reason why *t*-tests were used to find out if the effect of the different types of green manure on the dry mass of *Sorghum* was significant.

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.....[1]

(iii) Explain what is meant by:

statistically significant

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P < 0.05.

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(d) With reference to Table 2.1 and Table 2.2 only, state three conclusions that can be drawn from these results about the effect of using green manure on *Sorghum.*

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2. .....

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3. .....

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.....[3]

[Total: 16]

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